Ultrasonographic examination of the abdomen of the goat. II. Liver, spleen, urinary tract and greater omentum

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Abstract: This review article describes the ultrasonographic findings of the liver, spleen, urinary tract and greater omentum that were previously obtained in studies of healthy female Saanen goats. Real-time B-mode ultrasonography and a linear or convex 5.0 to 7.5 MHz transducer are used to scan standing goats from both sides. The urinary bladder and urethra are also examined transrectally. The liver is scanned from the intercostal spaces (ICSs) on the right from dorsal to ventral. The parenchymal pattern consists of numerous fine echoes that are homogenously distributed across the entire organ. The dorsal visible margin of the liver runs parallel to the lung in a cranioventral to caudodorsal direction. The visible extent of the liver is largest in the 7th and 8th ICSs and the maximum thickness is measured in the 10th ICS. The caudal vena cava has a triangular shape in cross section and is seen only at the 11th or 12th ICS. The portal vein is oval to circular in cross section with stellate ramifications into the liver parenchyma. The gallbladder is pear-shaped and sometimes extends beyond the ventral margin of the liver depending on the amount of bile. In most goats, the gallbladder is only seen from the 9th or 10th ICS. The spleen is scanned from the left where it is almost always seen from the 11th and 12th ICSs. The parenchymal ultrasonographic pattern is similar to that of the liver. The splenic vessels are embedded in the parenchyma and are seen in longitudinal or cross section. The kidneys are best visualized from the flank and last two ICSs on the right. The ultrasonographic appearance varies with the sectional plane. In a sagittal plane through the hilus, the parenchyma is homogenous with fine, evenly distributed echoes. The medullary pyramids are seen near the sinus as oval to circular hypoechoic structures. The hyperechoic sinus is at the centre of the kidney. The urinary bladder is best visualized transrectally but can also be seen in many goats from either inguinal region. The content of the bladder is usually anechoic and the diameter ranges from 1.0 to 4.8 cm. The urethra is seen transrectally as two adjacent parallel echoic lines without an apparent lumen.

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Table 1: Results of ultrasonographic examination of the liver in 27 female Saanen goats (mean ± SD, range in brackets) (reproduced from Braun and Steininger, 2011).

Variable	Intercostal space							
	5 (n = 5)	6 (n = 24)	7 (n = 27)	8 (n = 27)	9 (n = 27)	10 (n = 25)	11 (n = 19)	12 (n = 6)
Dorsal liver margin (cm)	31.4 ± 1.52 (29.0-33.0)	28.8 ± 2.80 (22.0-33.0)	25.1 ± 2.91 (19.0-29.5)	20.9 ± 2.94 (15.5-27.5)	17.0 ± 2.59 (11.0-20.5)	13.5 ± 2.79 (7.0-18.0)	9.7 ± 2.10 (6.0-14.0)	7.9 ± 1.28 (7.0-10.0)
Ventral liver margin (cm)	39.1 ± 6.28 (33.5-49.0)	41.3 ± 4.98 (29.5-51.0)	41.0 ± 4.23 (30.5-50.0)	36.8 ± 4.81 (28.0-46.0)	32.1 ± 4.53 (24.0-41.0)	27.0 ± 5.37 (18.0-43.0)	20.9 ± 4.61 (15.5-35.0)	18.5 ± 3.78 (13.5-23.0)
Size of liver (cm)	7.7 ± 6.66 (0.5-17.0)	12.9 ± 4.18 (6.5-22.5)	15.9 ± 3.72 (10.0- 23.5)	15.9 ± 4.74 (9.0-28.5)	15.2 ± 4.13 (6.0-22.0)	13.5 ± 3.98 (7.0-25.0)	11.2 ± 4.21 (4.0-22.0)	10.6 ± 3.35 (6.5-15.5)
Thickness of liver (cm)	NE	3.9 ± 0.94 (1.9-5.5)	4.6 ± 1.00 (3.3-7.0)	5.0 ± 0.95 (3.5-6.7)	5.0 ± 0.91 (3.5-6.7)	5.2 ± 0.79 (3.5-6.7)	5.0 ± 1.30 (1.4-6.4)	4.5[1]
Angle of liver (degree)	29.0 ± 6.56 (22.0-35.0)	27.5 ± 5.62 (17.0-40.0)	28.8 ± 5.96 (15.0-40.0)	32.6 ± 5.91 (19.0-43.0)	30.5 ± 6.68 (15.0-40.0)	33.5 ± 8.26 (20.0-53.0)	35.8 ± 10.56 (20.0-64.0)	47.4 ± 6.03 (40.0-55.0)
Hemi circumference of abdomen (cm)	44.4 ± 4.93 (38.0-50.0)	44.6 ± 6.50 (17.5-51.0)	45.2 ± 6.01 (18.0-52.0)	46.0 ± 5.59 (22.0-53.0)	47.4 ± 5.44 (26.0-55.0)	48.3 ± 5.69 (27.0-58.0)	49.8 ± 6.35 (29.0-59.0)	52.6 ± 5.08 (43.0-59.0)

NE Not examined because the portal vein could not be seen

[1] In the 12th intercostal space the thickness of the liver could be determined only in one goat, because the portal vein was visible only in one goat.

Table 2: Measurements of the kidneys in 29 female Saanen goats ($\bar{x} \pm s$, range in brackets) (reproduced from Steininger and Braun, 2012).

Variable	Right kidney	Left kidney
Length of kidney (cm)	n = 28 8.0 ± 0.67 (6.6 – 9.4)	n = 27 8.4 ± 0.64 (6.4 – 9.7)
Width of kidney (cm)	n = 26 5.2 ± 0.75 (3.9 – 6.4)	n = 25 5.0 ± 0.64 (3.9 – 6.3)
Thickness of kidney (cm)	n = 26 4.3 ± 0.63 (3.2 – 5.5)	n = 25 4.4 ± 0.55 (3.1 – 5.6)
Thickness of renal cortex (cm)	n = 28 0.9 ± 0.21 (0.4 – 1.3)	n = 27 1.0 ± 0.22 (0.6 – 1.4)
Thickness of renal parenchyma (cm)	n = 25 1.8 ± 0.53 (1.0 – 3.6)	n = 25 1.7 ± 0.41 (1.1 – 3.2)
Thickness of renal sinus (cm)	n = 25 0.9 ± 0.19 (0.5 – 1.2)	n = 25 0.9 ± 0.25 (0.4 – 1.5)
Diameter of medullary pyramid 1 (cm)	n = 28 1.2 ± 0.27 (0.7 – 1.8)	n = 25 1.2 ± 0.18 (0.9 – 1.5)
Diameter of medullary pyramid 2 (cm)	n = 27 1.2 ± 0.21 (0.8 – 1.7)	n = 25 1.2 ± 0.24 (0.9 – 1.8)
Diameter of medullary pyramid 3 (cm)	n = 27 1.3 ± 0.24 (0.9 – 2.0)	n = 25 1.2 ± 0.24 (0.8 – 1.8)